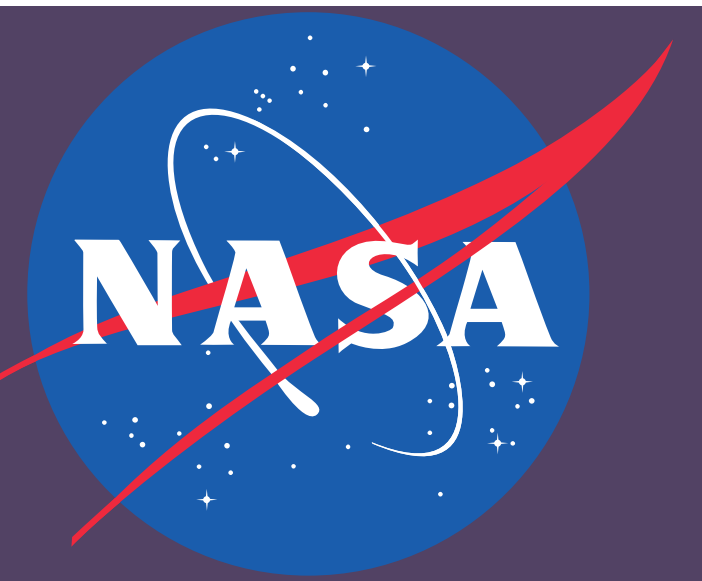# Dark Target Aerosol Retrieval for VIIRS with MODIS Continuity

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Continuity for Climate Studies

- Dark Target algorithm measures aerosol optical depth (AOD) by contrasting aerosol with a "darker" ocean or vegetated surface
- Goals for climate data record (CDR):
  - Global spatial coverage
  - 10km resolution
  - Accuracy better than 0.03 or 10% of AOD
  - Drift less than 0.01 per decade
  - Coverage spanning multiple decades
- MODIS has an expected lifespan into the early 2020s, resulting in 20+ year data record
- Dark Target for VIIRS can help meet CDR goals by extending MODIS record to VIIRS
- Identical VIIRS Dark Target algorithm can be applied to JPSS-1 and future JPSS missions

The VIIRS Dark Target retrieval (AERDT_L2_VIIRS_SNPP) performs MODIS-like retrieval with differences that conform to VIIRS instrument and other VIIRS data products:
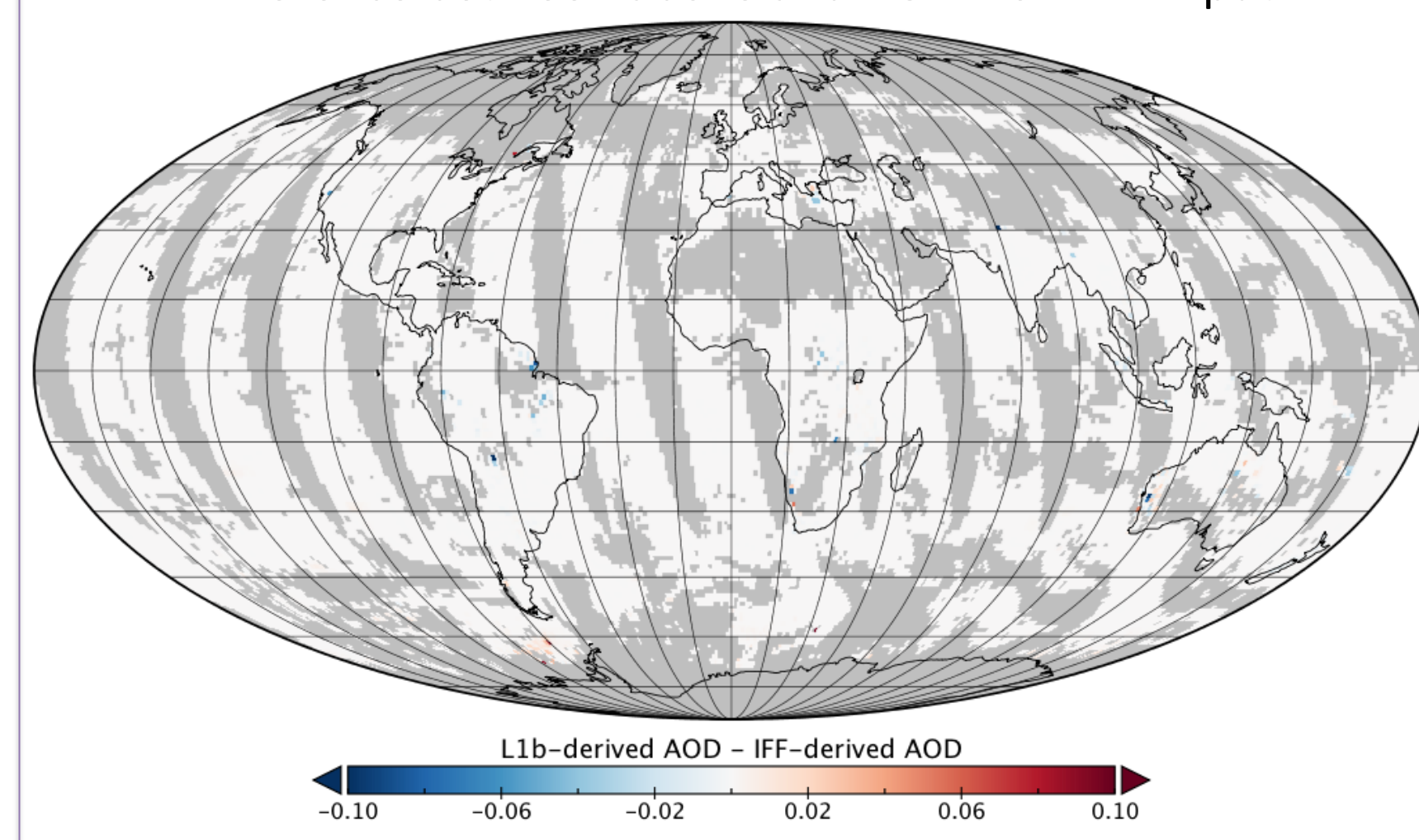
	MODIS Dark Target	**VIIRS Dark Target**
Nadir resolution	10 km	6 km
Ancillary cloud mask	Wisconsin Cloud Mask (M*D35)	MODIS-VIIRS Continuity Cloud Mask
File format	HDF4	netCDF4
Typical granule size	5 minutes, 203x135 pixels	6 minutes, 404x400 pixels

IFF to L1b Input


AOD 0.55μm, all QA, from L1b input, 2015-04-01
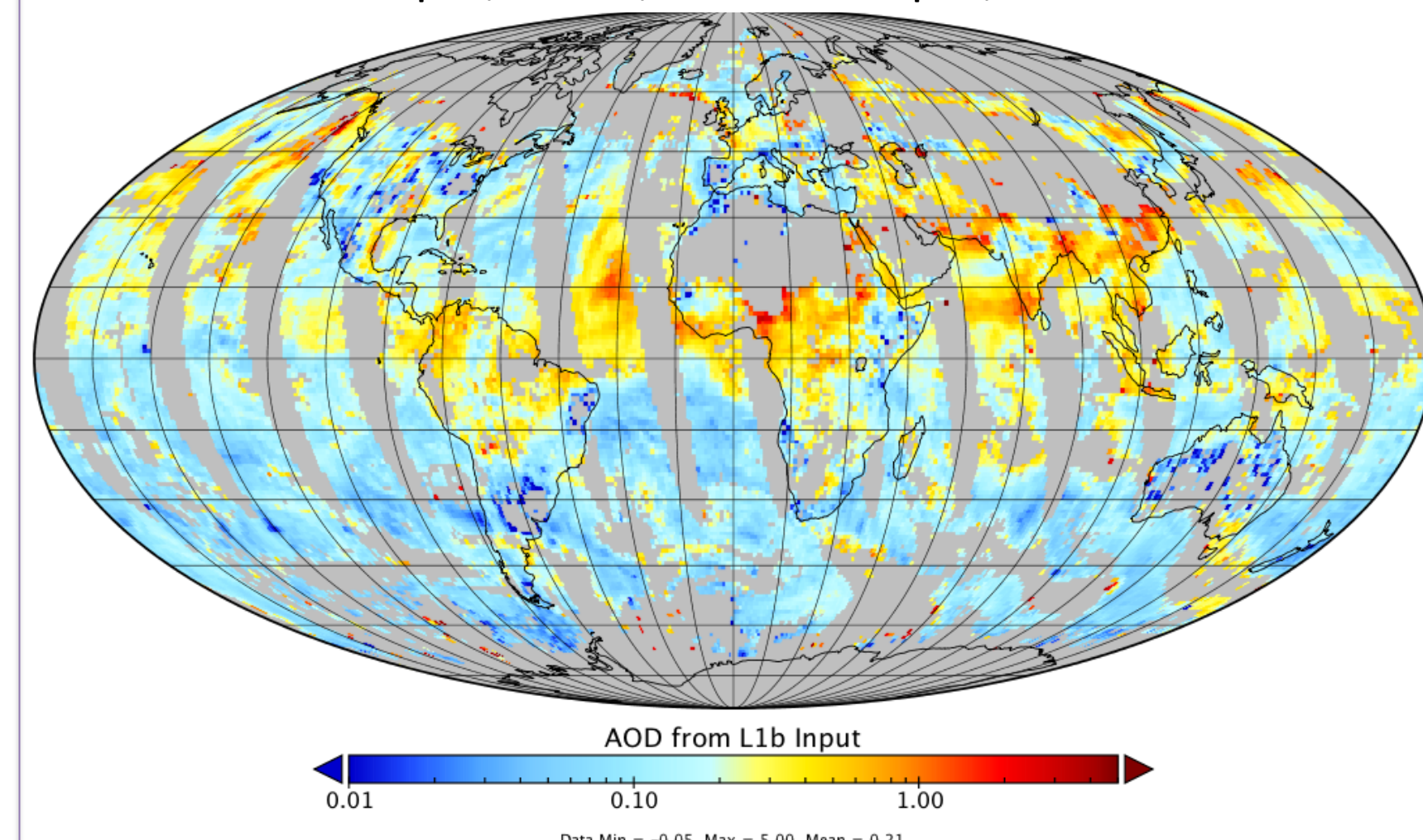
Difference between above and AOD from IFF input

Previous versions of VIIRS Dark Target relied on Intermediate File Format (IFF) input, which formats and processes VIIRS input more like MODIS:
- 5-minute granules
- HDF file format
- Included georeferencing
- Repaired bowtie deletions

New version retrieves directly from L1b with only minor sampling differences. The software package is delivered and testing on multi-day samples. Full VIIRS mission run coming soon!


Land

Ocean
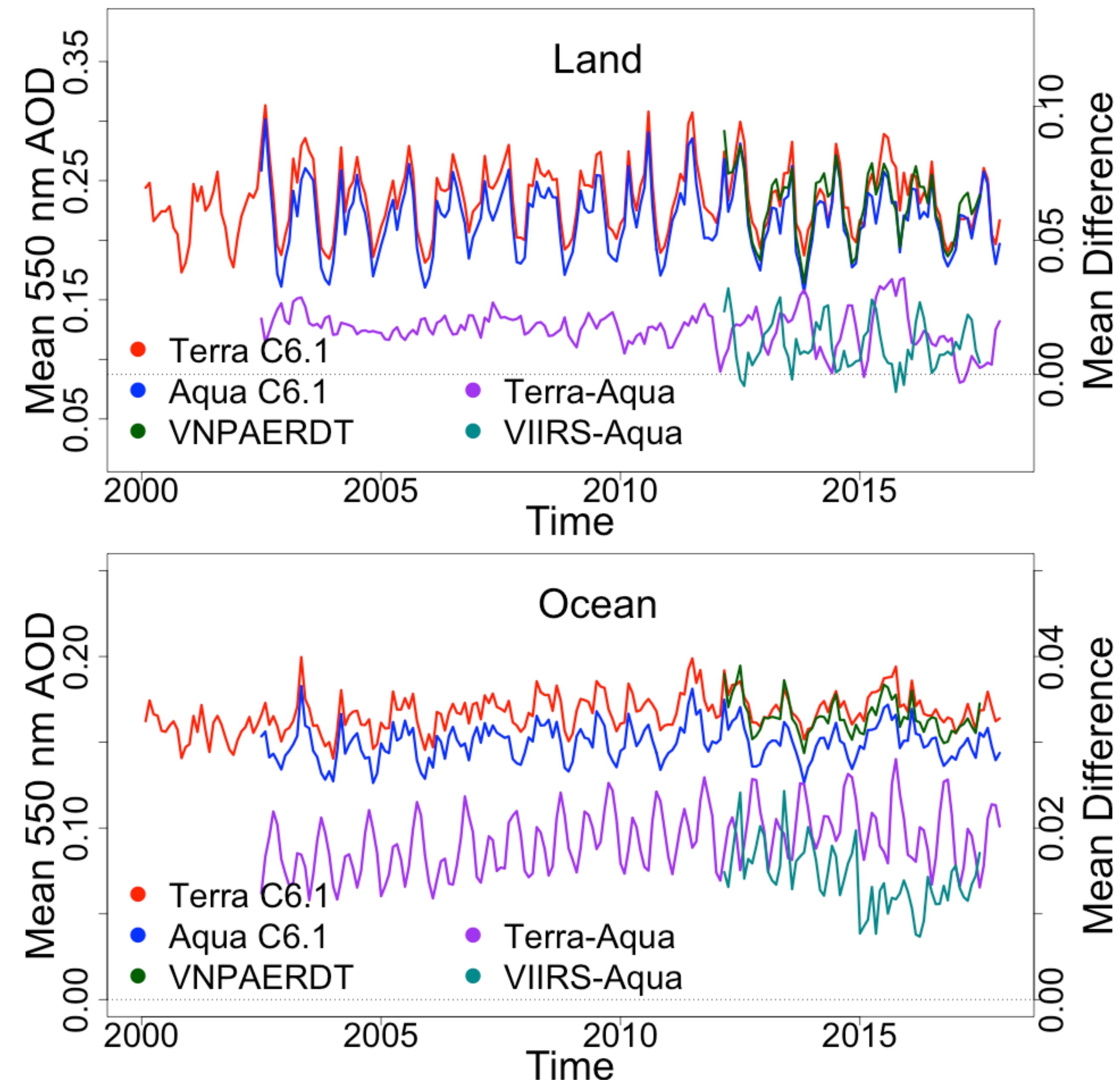
Timeline of area-weighted, QA-weighted monthly L3/L3-like AOD at 0.55μm, for MODIS-Terra C6.1, MODIS-Aqua C6.1, and VIIRS-SNPP version 1.0.3.

Comparison to MODIS C6 and C6.1

- The VIIRS Dark Target algorithm corresponds to MODIS C6 and does not (yet) incorporate C6.1 improvements
- Despite this inconsistency, MODIS C6.1 agrees better than C6 with VIIRS because of calibration improvements to L1b reflectances
- Validation with AERONET and MAN is in progress


Annual average Ångström exponent
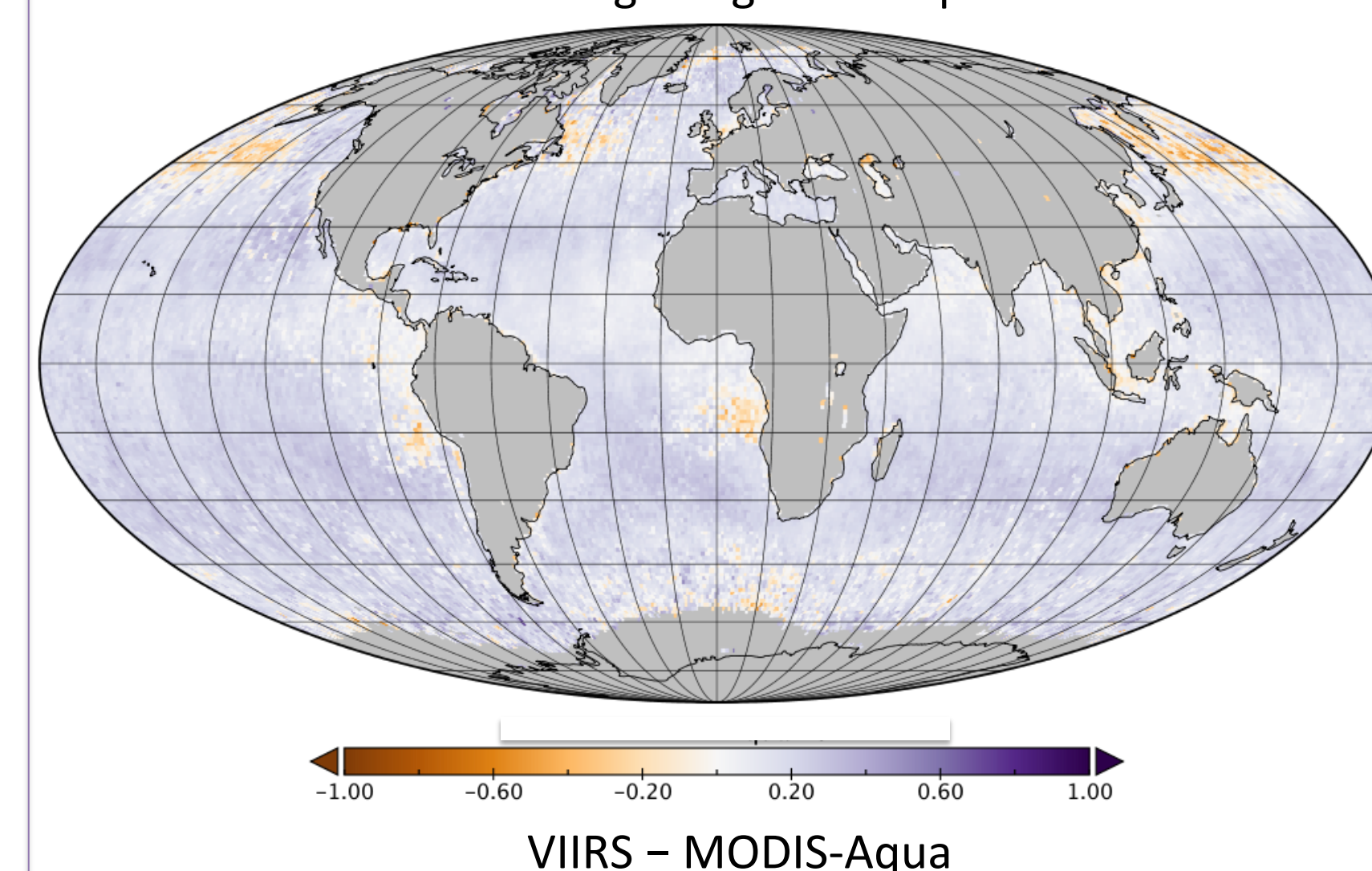
- The VIIRS Dark Target Ångström exponent is systematically higher than Aqua, with a greater average difference than between Aqua and Terra

- The Dark Target algorithm does not adjust for wavelength-specific differences in L1b reflectances between MODIS and VIIRS. AOD at 0.86μm is in better agreement than AOD at 0.55μm.

VIIRS – MODIS-Aqua AOD 0.55μm
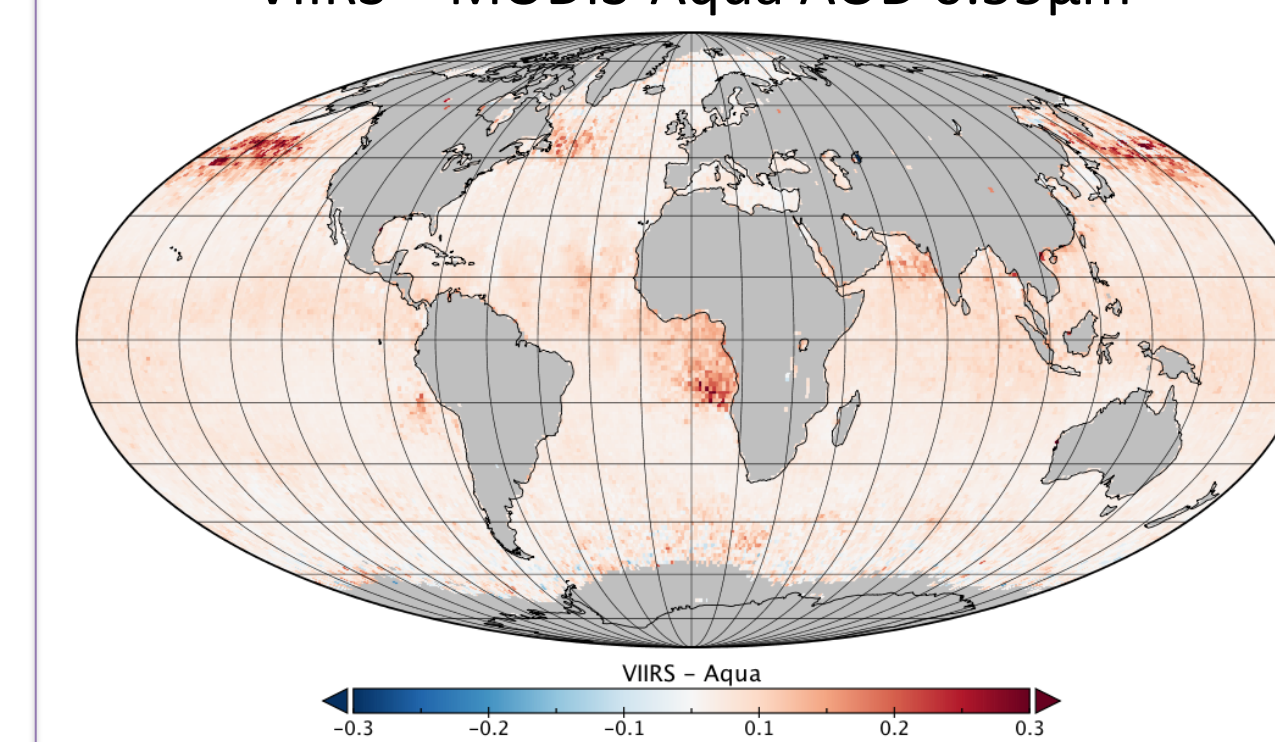

VIIRS – MODIS-Aqua AOD 0.86μm
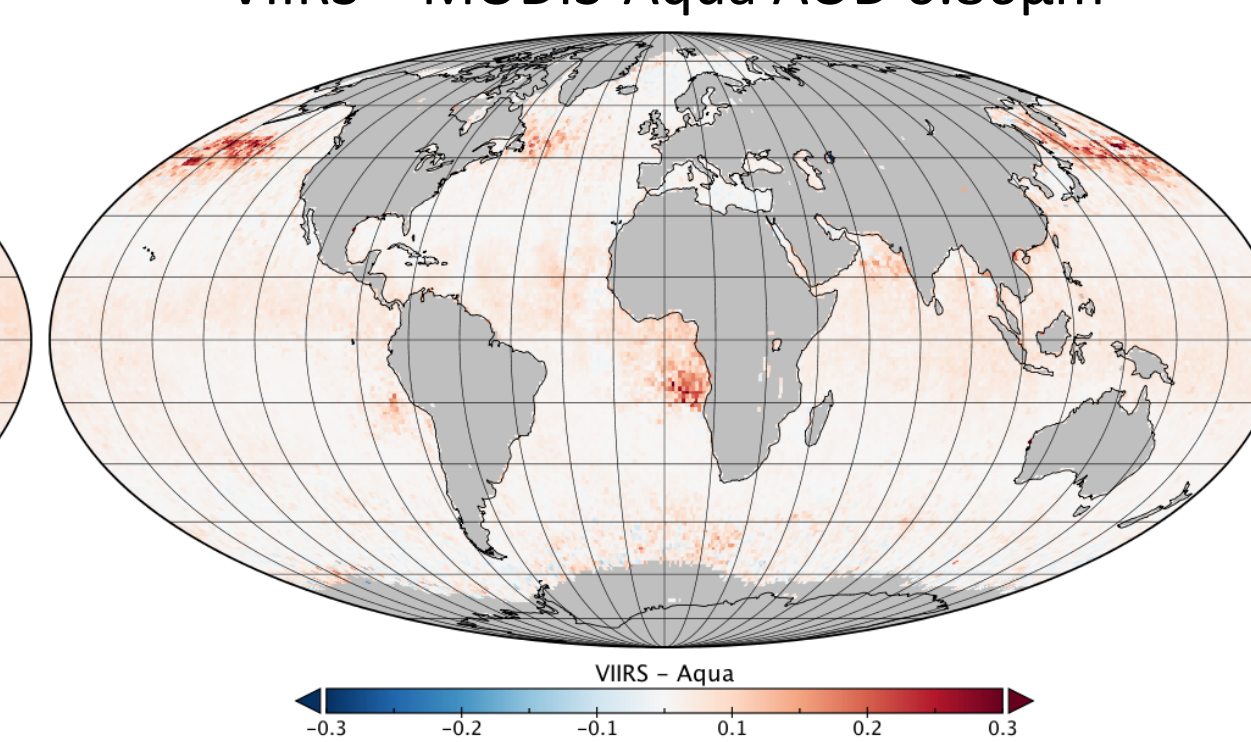
Resolution and Sampling

Cloud cover appears to drive some of the MODIS-VIIRS difference in AOD, but cloud mask disagreement is not the only explanation
- Higher-resolution cloud masks have a higher proportion of both 0% and 100% cloudy pixels
- Dark Target excludes 100% cloudy pixels from retrieval but keeps clear and partly cloudy pixels
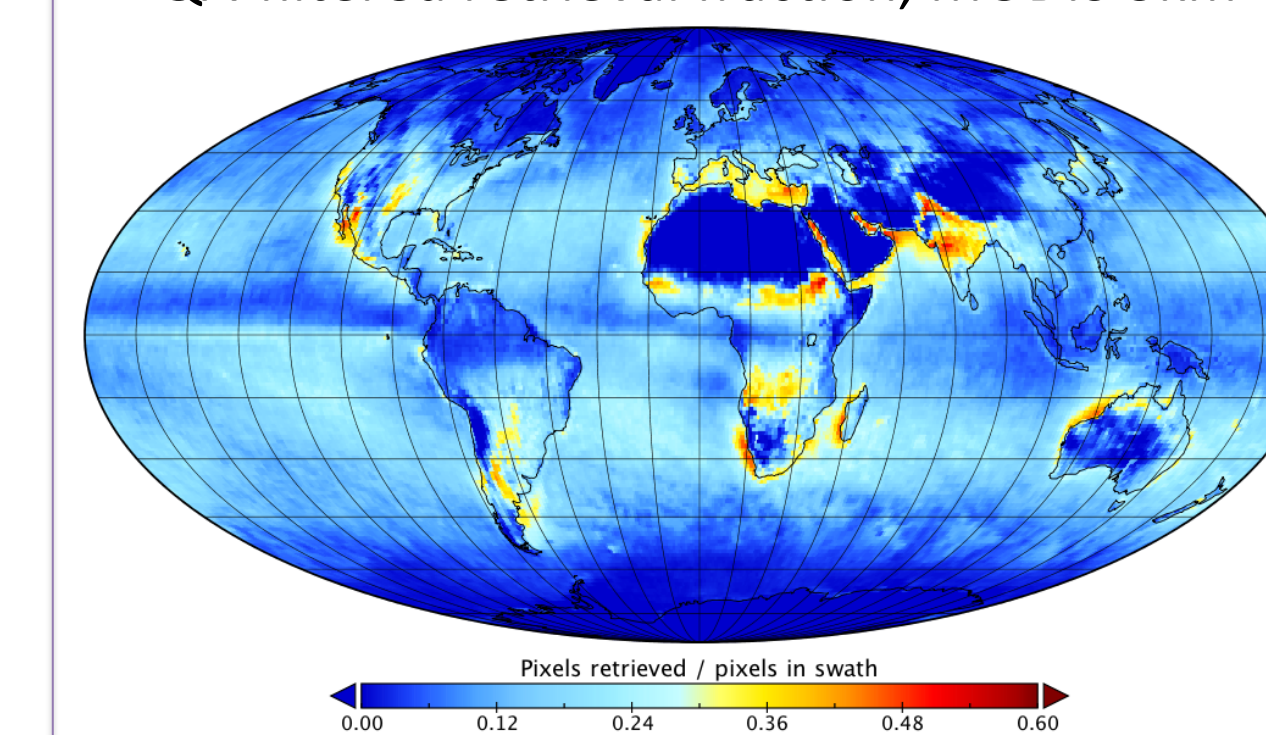- MODIS Dark Target samples reflectances at 10km and 3km, while VIIRS is 6km

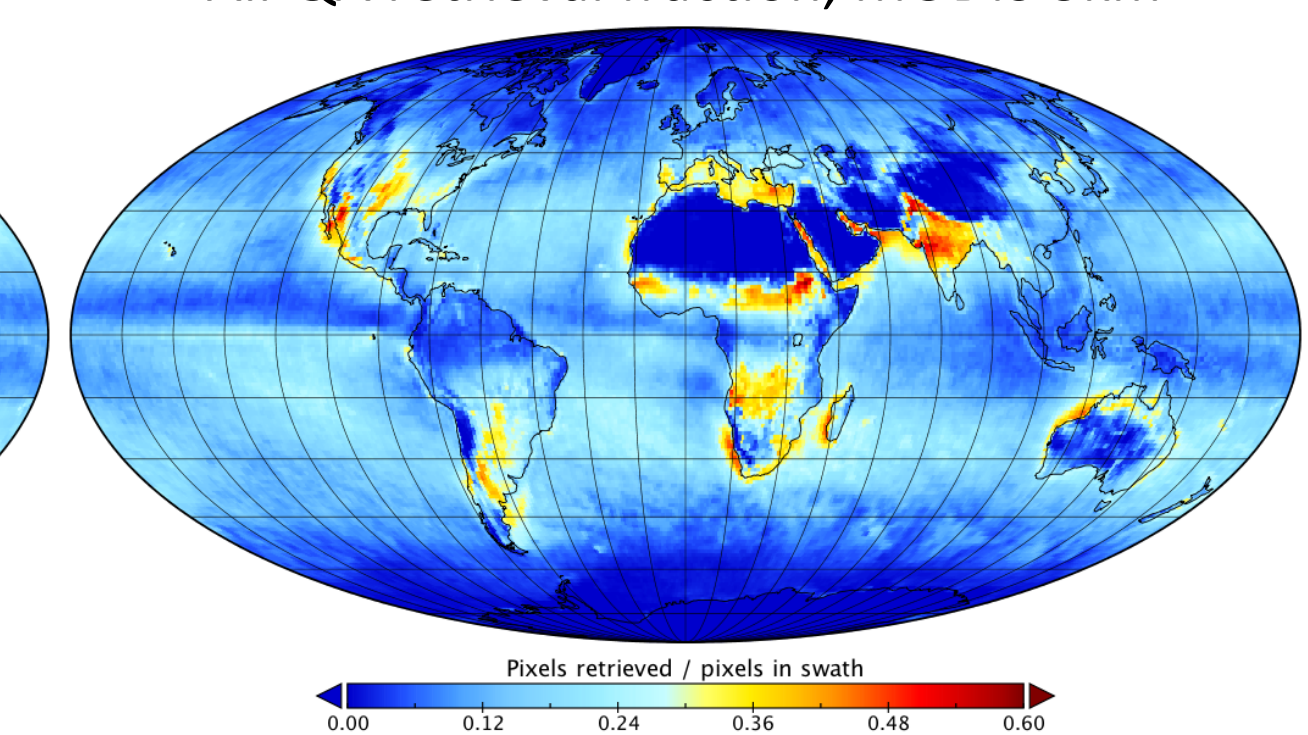QA-filtered retrieval fraction, MODIS 10km
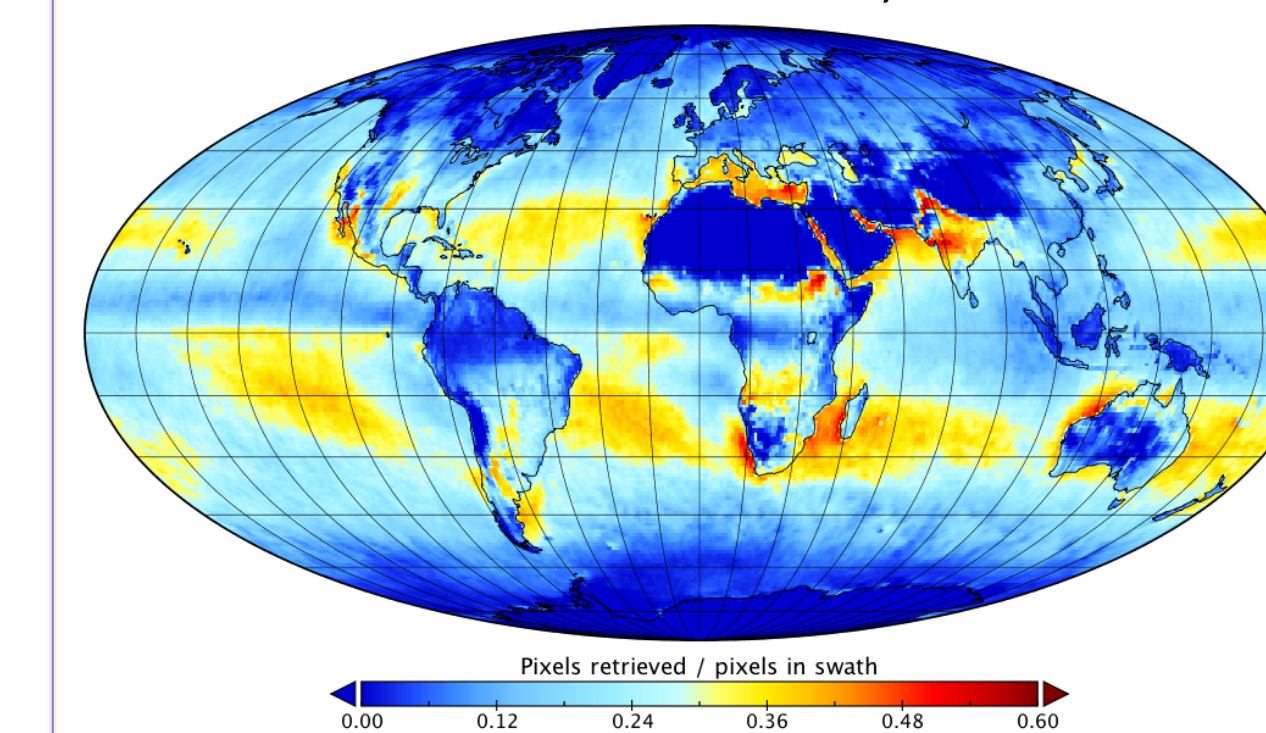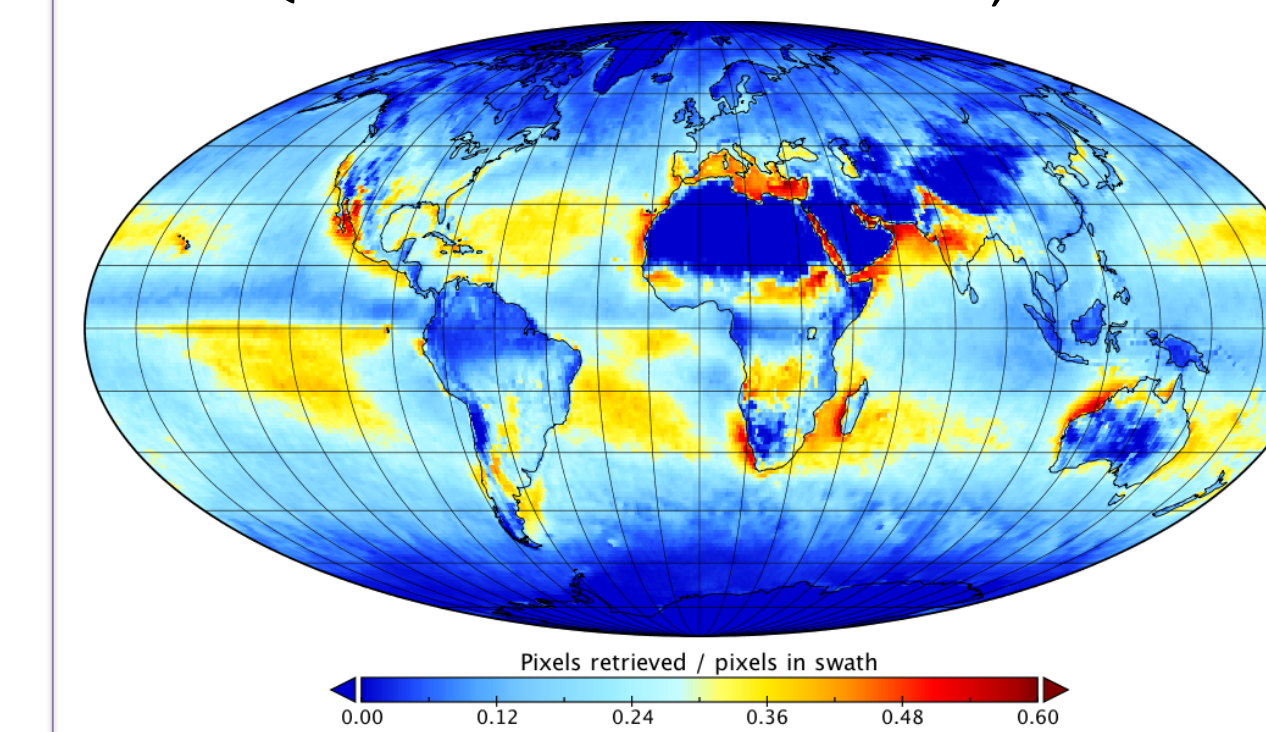

All-QA retrieval fraction, MODIS 10km
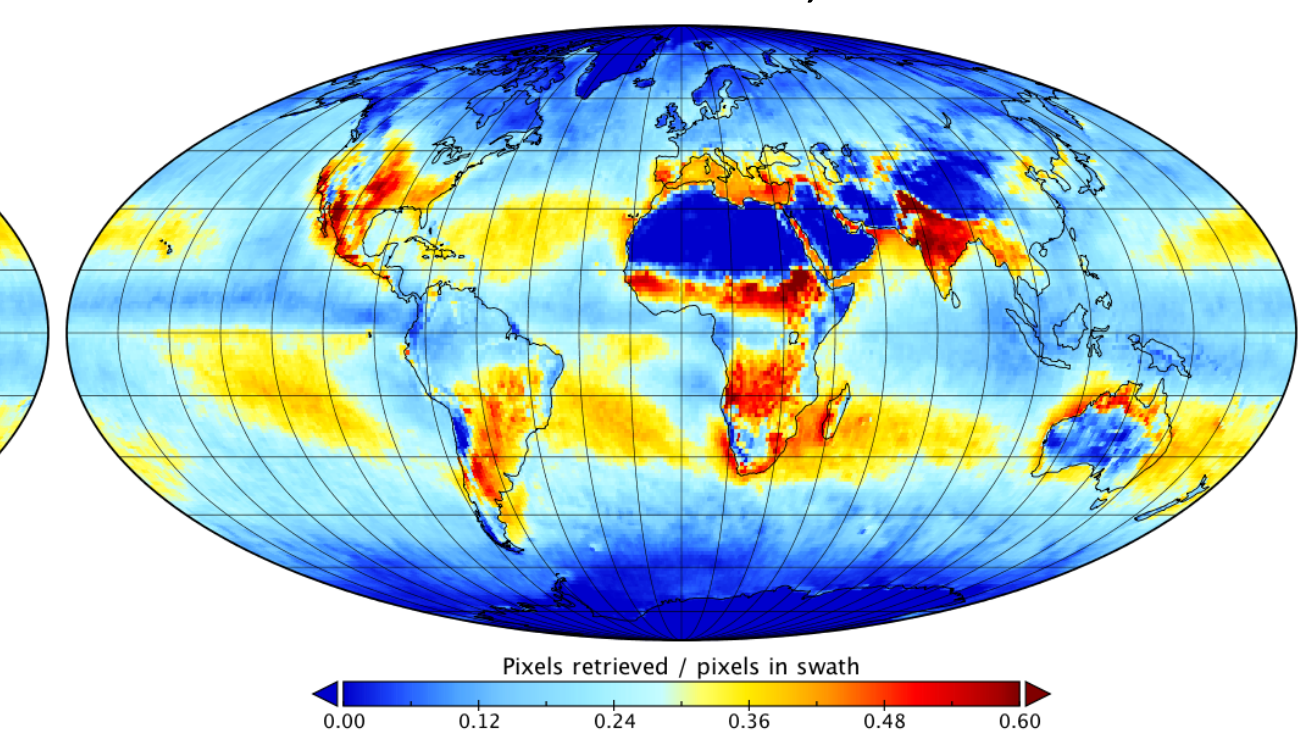
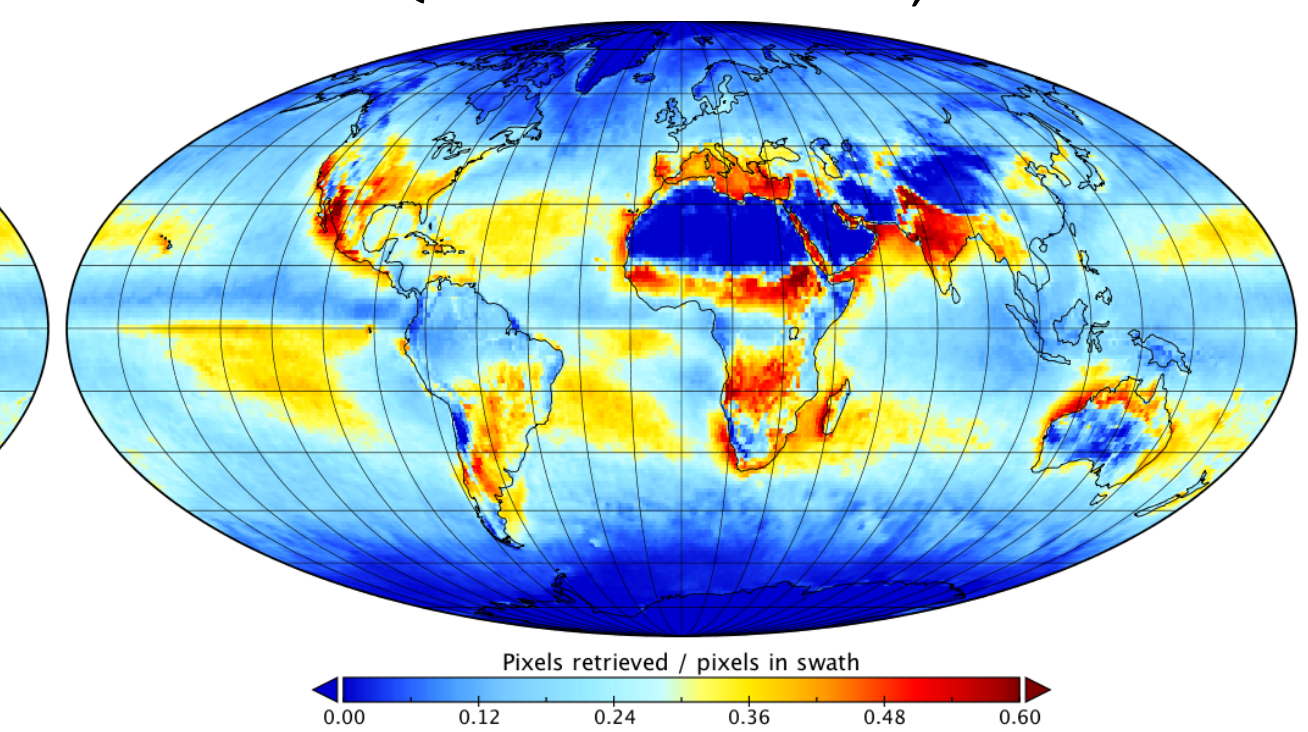QA-filtered retrieval fraction, MODIS 3km

All-QA retrieval fraction, MODIS 3km

QA-filtered retrieval fraction, VIIRS


All-QA retrieval fraction, VIIRS

Annual average fraction of pixels in the swath used for AOD retrieval. The total number of pixels in the swath varies significantly only at high latitudes. Over ocean, sampling is driven by cloud cover.

Algorithm Portability

The VIIRS software package is more self-contained than operational MODIS
- Easier to use to test algorithm improvements, especially with L1b input
- Easier to port to other instruments such as AHI and ABI

AOD 0.55μm from AHI and ABI, 2017-10-10 22:00 UTC
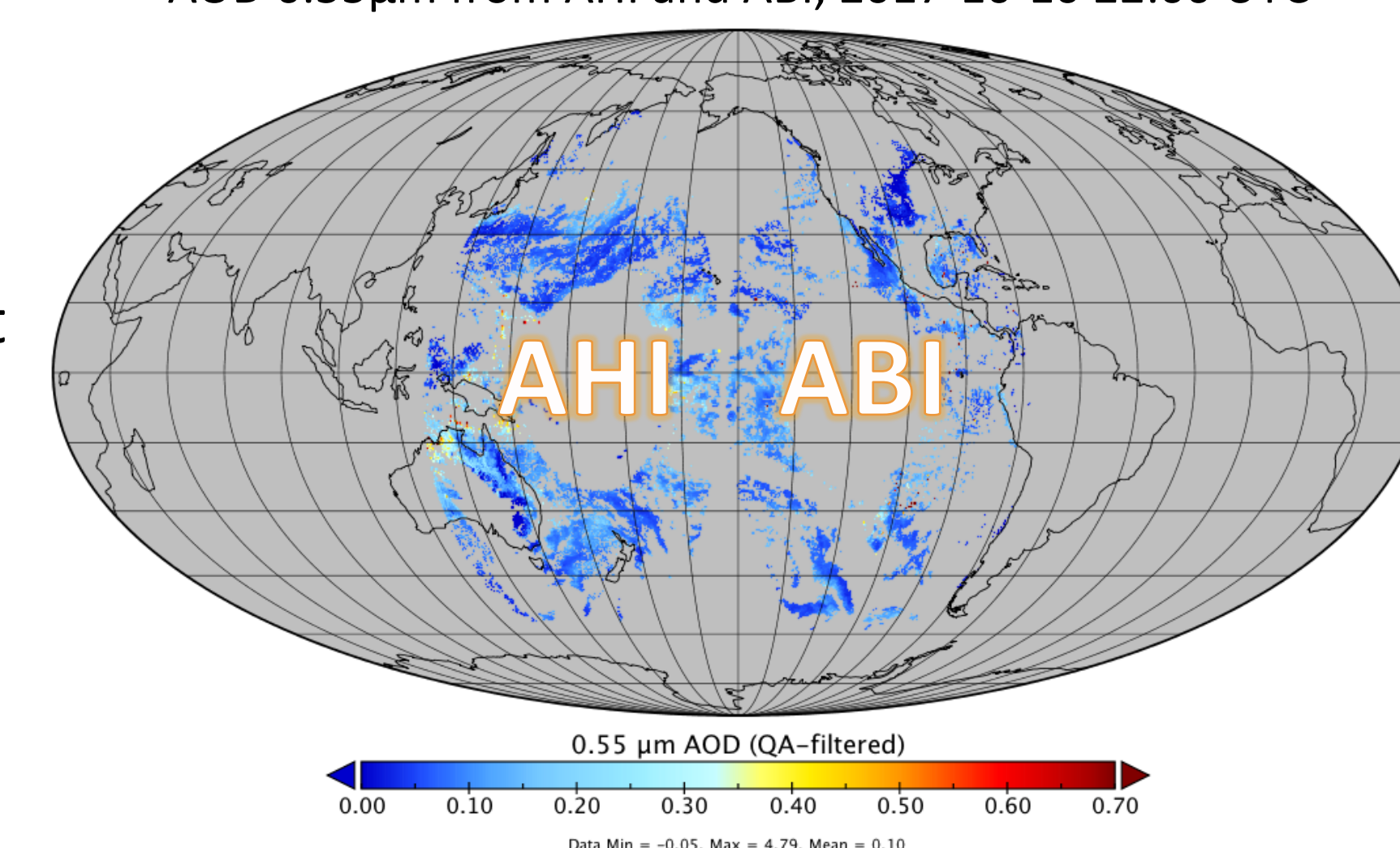
Future work includes Dark Target retrievals for AHI (Himawari 8), ABI (GOES-16), and a possible merged LEO/GEO AOD product at 30-minute intervals. We will also make the MODIS software package more portable and less dependent on system-specific toolkits.